White Paper

Reduction of HFC-134a Emissions from Non-Professional Servicing of Motor Vehicle Air Conditioning Systems

Research Division

California Air Resources Board

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Abstract

A suite of strategies in the AB 32 Early Action Plan was developed to reduce the emissions of HFC-134a used for motor vehicle air conditioning (ARB, 2007a). The reduction of HFC-134a emissions from nonprofessional servicing of motor vehicle air conditioning (MVAC) systems falls within this suite of strategies and was identified by the Board as a discrete early action. This measure would predominantly affect the do-it-yourself (DIY) individual who recharges his own personal vehicle air conditioner. Originally, staff proposed a ban on the retail sale of HFC-134a refrigerant in small cans. We have reconsidered that idea for the reasons stated in this document. The ban is still an option that will be included in the analysis presented in the staff report and may be chosen by the Board. However, staff is recommending an alternative option that includes requirements for:

1. A self-sealing valve on all containers of HFC-134a refrigerant less than 30 lbs intended for MVAC use.
2. An industry-operated mandatory can deposit and refrigerant recycling program,
3. Mandatory increases in the recycling incentive deposit at set intervals until a 95% recycling rate is achieved,
4. Improved instructions for use on the can, and
5. A comprehensive consumer education course describing the legal, environmental, and MVAC issues associated with using small cans for DIY recharge. The consumer education material would be available free of charge at the point of sale and over the internet.

Staff believes the proposal is a sensible and effective alternative and should be weighed carefully against a ban. The alternative achieves reductions of 0.22 $MMTCO_2E/yr$, which is about 50% of the 0.47 $MMTCO_2E/yr$ potentially achieved by a ban, while doing so at a cost of $\$9/MTCO_2E$, which is about 7% of the $\$135/MTCO_2E$ cost of the ban, and does so without negative consequences among the Environmental Justice (EJ) community. Like the ban, the alternative proposal is a model exportable to other states. In addition, a carbon mitigation fee can be added without changing the structure or benefit of the proposed regulation.

This new rule will likely lead to some voluntary shifting of MVAC servicing from the DIYer to the professional A/C technician. However, professional servicing of MVAC systems is not an emissions-free practice. Addressing emissions from professional servicing of mobile A/C systems is not part of this discrete early action, but, staff acknowledges that emission improvements are also urgently needed in that area. A separate rulemaking is in progress to address professional servicing.

For example, professional service technicians could be required to undergo training and obtain a certificate prior to servicing MVAC systems—a Federal

requirement not currently enforced by California. That rulemaking will likely specify that 30-lb and larger HFC cylinders can only be purchased and handled by professionals who are certified to do A/C servicing according to a new California program (ARB, 2008c). Professionals could also be required to recycle and recover refrigerant from larger cylinders.

1. Introduction and Background

HFC-134a is a hydrofluorocarbon (HFC) used as a refrigerant in motor vehicle air conditioning (MVAC) systems. It replaced the refrigerant R-12, a chlorofluorocarbon identified as an ozone depleting substance (ODS) under the Montreal Protocol. HFC-134a is not an ozone depleting substance, but is a potent greenhouse gas (GHG) with a global warming potential (GWP) of 1300 (IPCC, 2007). The California GHG emissions inventory suggests that high-GWP GHGs constitute about 3.5 percent of the total CO_2 equivalent emissions in 2002. A preliminary estimate of HFC-134a emissions in California during 2004 is approximately 9 million metric tons CO_2 equivalent ($MMTCO_2E$) (ARB, 2008a). About 5 million metric tons of those are from motor vehicle air conditioning applications (Based on nationwide ratio of MVAC to Total HFC-134a use in EPA Vintaging Model, private communication from EPA staff).

Under normal operation, a vehicle may slowly and naturally lose refrigerant due to "normal" leakage and permeation. Larger leaks are generally due to compressor leaks, and malfunctioning hoses and connections. When a vehicle's air conditioning system loses about 40% of its design refrigerant charge, cooling effectiveness suffers and the vehicle owner has two choices for recharging. The system can be recharged or "topped off" using small cans of HFC-134a purchased at retail auto parts stores, or it can be serviced by a professional auto shop certified to perform A/C maintenance. Do-it-yourselfers (DIY) purchase small cans of HFC-134a in retail stores for approximately $10 (NPD, 2008). Nominally, two or three 12-oz cans are sufficient to fully recharge an empty MVAC system of a passenger car.

A vehicle owner saves money by recharging an MVAC system with small cans of refrigerant compared with having a professional perform the recharge. However, the DIY may not properly identify the leak or repair it due to a lack of adequate training and/or equipment. It is likely that DIY recharge of an MVAC system may unintentionally release more HFC-134a than a recharge performed by professionally trained and industry-certified technicians at a licensed auto repair facility. There is also increased risk of damaging the system by over- or under-charging the proper amount of refrigerant and lubricant in the system. Proper lubricant level is essential to maintain optimal performance of both the compressor and the evaporator. The DIY cans may include leak sealants and leak detector compounds to assist the DIY in finding and stopping leaks, but these compounds seriously interfere with the SAE approved equipment and

procedures required by California law to be used by professional MVAC service technicians.

Related Regulations

There are several existing regulations related to automotive refrigerants. In September 2004 (under AB 1493, Pavley), the Board approved regulations for new passenger vehicles and light duty trucks beginning with the 2009 model year (ARB, 2005). The new regulations apply to CO_2 equivalent emissions that include HFCs used in MVACs.

A regulation recently approved by the ARB requires the Environmental Performance label on all new California vehicles to include information about emissions of global warming gases, including those from the operation of the air conditioner (ARB, 2008b). This information will allow consumers to compare relative greenhouse gas emissions between different vehicles. The new label will be affixed to the window of every new car sold in California beginning with model year 2009.

California recently approved a regulation requiring that gases used in consumer product Pressured Gas Dusters must have a GWP less than 150 to take effect on December 31, 2010 (ARB, 2008e).

Another regulation currently in development is based on measures to reduce the solar heat load on vehicles parked in the sun (ARB, 2008d). A cooler interior would reduce greenhouse gas emissions by causing drivers to use less air conditioning. Potential approaches include reformulation of paint to reflect near-infrared sunlight ("cool paints"), parked car ventilation, and solar reflective window glazing. This measure is planned for a Board hearing in March 2009, and would affect model year 2012 and later vehicles.

ARB is also developing a suite of measures to reduce emissions of high GWP refrigerants from stationary sources. One measure would require commercial and public facilities with large stationary air conditioning and refrigeration equipment to minimize emissions of high GWP refrigerants through reporting, leak repair, improved servicing, and end-of-life control (ARB, 2008c). Another measure proposes new specifications for commercial and industrial refrigeration systems to both reduce emissions of high GWP refrigerant and to increase energy efficiency of the units (ARB, 2008f).

Several local air districts in California prohibit the release of refrigerants into the atmosphere and restrict the sale of small cans. However, those local rules apply only to ODS such as CFC refrigerants, and not to HFC-134a.

The state of Wisconsin has regulations prohibiting the sale of refrigerant in small cans and restricting the sale and use of refrigerant in larger containers to

certified, state-registered technicians (ATCP 136). Recently, the State of Minnesota considered a restriction on the sale of small cans of refrigerant but decided not to adopt it. Instead Minnesota will require reporting of purchases of high-GWP gases, including automotive refrigerants. Minnesota will also require automobile manufacturers to report the refrigerant leak rates for new vehicles sold in the state, and these reports will be available to the public (Minnesota Senate, 2008).

The U.S. EPA prohibits venting refrigerants, including HFC-134a to the atmosphere during servicing and repair of MVAC systems and during dismantling at end of life. EPA also requires MVAC technicians to be certified (40 CFR §82.154). In the European Union, small cans have never been allowed, and large bottles of refrigerant can only be sold to certified air conditioning technicians. In addition, the European Parliament has adopted a prohibition of HFC-134a in new vehicles types starting in model year 2011 (European Parliament, 2006). Only refrigerants with GWPs less than 150 will be allowed in the EU. Life Cycle Climate Performance (LCCP) studies are being investigated to determine which refrigerants offer the best LCCP globally and for specific regions such as the U.S. (Papasavva et al., 2008).

2. Emissions and Inventory

ARB surveyed manufacturers of small cans of HFC-134a to obtain 2006 sales data. Estimates from the survey indicate that about 2 million small cans were sold in California in 2006, containing about 654 metric tons of HFC-134a (ARB, 2007b). This amount of refrigerant corresponds to sales of 0.85 $MMTCO_2E$ per year. Based on information from a small can industry consortium (ARPI, 2008a) and a study by an MVAC trade association (Atkinson, 2008a; and MACS, 2008), an estimated 83% of total small cans sales are being used by DIY. This amounts to 0.71 $MMTCO_2E$ per year. The rest is sold to professional shops.

During a DIY recharge, refrigerant may be emitted in three different ways:

1. Emissions due to refrigerant release from the MVAC system when the system is breached or from incomplete transfer of the can's content to the MVAC system (some content is vented to atmosphere); and
2. Emissions from the disposal of cans, which are known to contain some refrigerant following a recharge (can heel).
3. Failure of the DIY to repair any repairable leak(s) in the MVAC system.

Based on ARB research in progress (Clodic et al., 2007), the above emission processes account for the following percentages on average for DIY servicing:

1. *Servicing losses*: 11% is emitted directly to the atmosphere during the charging procedure, and

2. *Can heel*: 22% remains in the can as heel. Because most cans do not have sealing valves, most of this is released almost immediately to the atmosphere.
3. *Delayed emissions:* 67% of initial mass contained in the can is effectively charged into the system (this will eventually leak to the atmosphere if leaks are not repaired).

The immediate emissions due to the DIY servicing are approximately 0.23 $MMTCO_2E$ per year (points 1 and 2 above) and the emissions from the leaking MVAC systems are approximately 0.48 $MMTCO_2E$ per year (point 3 above). Much of the immediate emissions are due to improper technique. Twenty-five percent of the DIY operation contributes 60% of the immediate emissions (Clodic et al., 2007). Figure 1 illustrates the sources of emissions associated with DIY small cans.

ARB staff estimates that there are 1.2 million vehicles in California that receive DIY recharging (DIY vehicles) at an average rate of once per year, and using an average of 1.3 cans per recharge. This translates approximately into 1.2 million DIY users. Among these DIY users, about 15% are estimated to qualify as low-income households (Frost and Sullivan, 2006). A low-income household has an annual income of less than $35,200 based on 2008 standards. This is calculated as twice the Federal Poverty Line for a household of 3, which is similar to what the Health and Safety Code defines for the automotive repair assistance program.

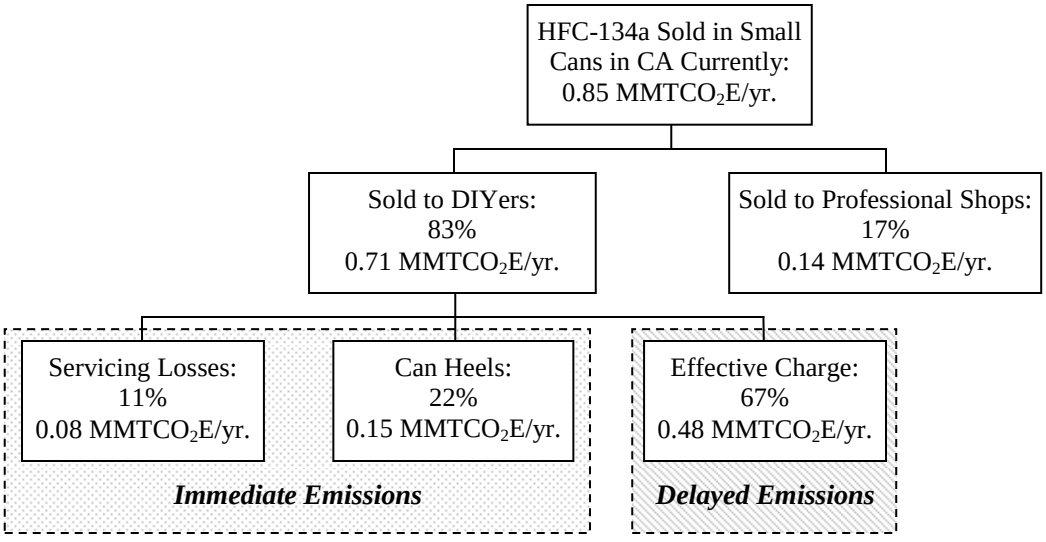

Figure 1. HFC-134a Emissions Associated with DIY Small Cans

3. Potential Regulatory Options

ARB staff has considered several options for reducing emissions from nonprofessional servicing of MVAC systems. They are analyzed chronologically

below. Although staff is recommending a recycling and education alternative, the original option, a prohibition on the retail sales of small cans, is still open for consideration by the Board. Some aspects of the measures may impact professional servicing, but professional servicing is being addressed in separate measures.

3.1 Prohibition of Can Sales

An option proposed by ARB would restrict the sale and import of the small cans of refrigerant and allow only professional servicing of MVACs. As indicated earlier, both the State of Wisconsin and the European Union prohibit the sale of small cans of refrigerant. More recently the State of Minnesota considered enacting a can ban, but did not include it in their final MVAC refrigeration regulations. The intent of this proposal would be to eliminate DIY servicing and the emissions that go with it. MVACs would be serviced and repaired, if necessary, only by trained certified technicians under this proposal. Some consumers would forgo air conditioning in order to avoid the added cost, and some would take their vehicle to the professional shops, which in California are required to conduct complete diagnostics. Based on Mobile Air Conditioning Society (MACS) trade association survey data, most vehicles brought to a professional shop are repaired before recharging (Atkinson, 2008b). The average cost of repair is about $650 in 2007 Dollars (MACS, 2008).

Eliminating the sale of small cans does not cause a net emission reduction equal to the small can sales volume. Instead it shifts MVAC servicing and its associated emissions from DIY to professional technicians. Professional technicians are assumed to be more skilled and emit less than DIYers. That explains why no emission reductions are associated with the sales prohibition for the fraction of small cans already used by professionals. The shift from DIY to professional servicing does have several effects that help reduce emissions: Losses during servicing are reduced because professionals let less refrigerant escape during servicing than DIY. Losses due to can heel are smaller because the heel left by professionals in 30 lb cylinders is smaller on a relative basis than the heel left in small cans by DIY (U.S. EPA, 2007). Likewise heels left in small cans by professionals are probably smaller than the heels left in small cans by DIY. Delayed emissions from leaking systems are less because the professional can identify and repair leaks that the typical DIY can not. (California law requires that professional service technicians must provide a complete diagnostic evaluation to the consumer before recharging an MVAC system, but does NOT require that repairs be performed before recharging the MVAC system. Despite the absence of a repair requirement, MACS survey data show that most consumers elect to complete repairs (Atkinson, 2008b).) Finally, the shift to professional servicing moves the handling and use of refrigerant from the general consumer to a much smaller group of technicians, more able to be licensed and monitored. Although no requirements on professional technicians or on the handling of heels from 30 lb cans are included in this specific measure, they are

being addressed in separate measures discussed later in this white paper. These measures are moving on a parallel timeline.

Eliminating small can sales also raises the consumer cost of MVAC servicing. The DIY public would no longer be able to top off their system for tens of dollars. Instead they would need to get their MVAC serviced by professional technicians. A diagnosis and top off would cost about $100 (Clodic et al., 2008), and repair of system leaks would cost many hundred dollars. Because of the increased costs, some consumers would choose to do without air conditioning. Data from the Frost and Sullivan Study (Frost and Sullivan, 2006) and a MACS study (Atkinson, 2008b) indicate that 21% of vehicle owners will choose neither repair nor recharge for their systems; they would go without air conditioning and their emissions would go to zero. Based on the same study, another 10% of vehicle owners will have professionals top off their systems rather than repair them, which is currently allowed by Federal and California law. Therefore, these systems would continue to leak emissions at the same rate, though the former DIY would pay about 10 times what they otherwise would have paid for virtually no reduction in emissions. About 49% of vehicle owners will elect professional repair, thereby reducing system leaks. And 20% "program leakage" will occur as consumers bring product into the state from the outside, resulting in no emission reductions. We estimate that the emission reductions under the can ban proposal would be only 0.47 $MMTCO_2E$ per year, which is 55% of the small can refrigerant sales. The derivation of this estimate is discussed in the supporting document *Staff Analysis on Emissions and Economic Impacts of Regulatory Proposals for DIY Recharging of Motor Vehicle Air Conditioners Using Small Cans.*

Under business as usual (BAU), DIY users of the small cans typically pay $10 to $40 for refrigerant and equipment needed to recharge their system. With the can ban, the DIY cost will increase as the consumer will now have to obtain professional servicing and repair at an average cost of about $650 per visit. The average cost was obtained from a MACS-sponsored survey and covers inspection, repair of refrigeration circuit problems, and recharge (MACS, 2008). This is a significant increase in cost compared to the DIY simply buying one or two cans. It is a particular concern in the EJ community (EJAC, 2007), and a concern shared by ARB. There is fear that an undue economic burden will be placed on the low-income public. If the increase in repair cost forces a person to forgo A/C altogether, the situation might become a personal health and welfare burden if air conditioning is not available. But analysis of heat related mortality data suggest that an effect on mortality is very unlikely. The estimated increase in consumer cost is $63 million per year. The cost per metric ton of reduction borne by the consumer is approximately $135/$MTCO_2E$. In addition, the small can industry would experience approximately $25 million in lost revenue per year.

Enforcement activities against "program leakage" practices would be very similar to the activities for other programs. These will include monitoring internet sites to

ensure that they do not sell small cans to California residents, tracking imports from neighboring states or countries, and investigating illegal sales in California (black market). A notification will be sent to all retailers and distributers with the ban date and the last date of the sell-through period prior to these dates. Inspectors would be required to check the shelves of California retail stores carrying automotive products to ensure that sales have ceased.

3.2 Industry Proposal and Recycling Program

An alternative proposed by industry in response to the can ban would reduce the emissions during servicing and reduce emissions from the can heel. This proposal would require that:

1. Manufacturers incorporate self-sealing valves into the small cans of refrigerant sold at auto parts stores and other retail outlets.
2. Manufacturers improve the instructions on the can to promote better recharge technique and thereby reduce losses during service and the size of the can heel;
3. Regulations establish an industry-operated mandatory requirement to recycle small cans and recover the can heels through a cash deposit and return program. The recycle program would include:
    a. the purchaser would pay a deposit on each can;
    b. the deposit would be returned to the customer when he returns the can to the retailer or other designated center;
    c. the recycled cans would be returned to centralized locations equipped for proper recycling or destruction of the refrigerant;
    d. the can heels would be recovered and either recycled or destroyed;
    e. the used can would be recycled as scrap metal.

The combination of can valve and improved instructions may significantly reduce losses during DIY servicing. Servicing emissions are estimated to drop by 90% resulting in a net reduction of 0.07 $MMTCO_2E$. In addition, the industry proposal would reduce the “can heel” emissions by providing an incentive to return the used can. Assuming a container return rate of 75% (most realistic estimate), a net reduction of 0.12 $MMTCO_2E$ per year would result. Total emission reductions associated with the industry proposal are thus 0.19 $MMTCO_2E$ per year. As discussed later, enhancements of the basic industry proposal would result in a higher return rate.

According to industry estimates, this proposal increases the price of a can by about $1 per can to cover the improvements in can design and the operating expenses of the recycle program. At 1.6 million cans per year (counting only the fraction of cans sold to DIY) the increased consumer cost is $1.6 million. The consumer would also bear the deposit cost on unreturned cans. For the can deposit, assuming a 75% can return rate and a $5 deposit per can, the 25% of unclaimed deposits equals $2 million per year borne by consumers who fail to return the cans. Total increased cost to the consumer is thus $3.6 million per

year, which works out to be $19/MTCO$_2$E. This estimate is an average and includes the cost of 25% of the cans not being returned. Industry conducted a test program to determine the effectiveness of a deposit and return program. Results indicate a $5 deposit per can generated a return rate of about 75%. Again, enhancements discussed later allow this rate to be raised to 95%.

This regulatory approach does not address emissions due to leaking, unrepaired MVAC systems. The DIY practice can result in a pervasive leak-recharge-leak cycle with continuing high-GWP emissions to the environment because the DIY may not have the expertise and/or equipment to properly repair any system leaks.

The recycling program would require that industry specify a number of administrative details and procedures. These would be included in a regulation and would include components such as target recycling rates, reporting requirements, audit requirements, public education, and a deposit handling mechanism.

Enforcement concerns for this approach do not appear insurmountable. These include stating documented procedures for establishing and operating recycling centers, can storage, refrigerant recovery, recycling or destruction, the handling and flow of money, and the prevention of fraud. This last area is of particular importance because the deposit amounts are substantial and previous experience has shown that people may attempt to gain a financial advantage when the opportunity exists. For example, people may attempt to submit non-California cans to claim deposits, intercept and resubmit cans already received for deposit, misinform consumers on rights to claim deposits, etc. Periodic audits by ARB or its contractor would be required of the recycling program.

In order to determine the effectiveness of the program, it would be necessary for retail stores to keep records of small can sales and returns and for recycling centers to keep records of the used can returns. These records would be compiled in a report and sent to ARB staff.

A certification program with performance standards for the self-sealing valves would be required to ensure that new or used cans have minimal leakage. The manufacturers of small cans will have to perform independent testing on new and used self-sealing valves every three years to assure that they meet the performance specifications on a continuing basis.

3.3 Auxiliary Approaches Considered by ARB Staff

There are additional mitigation options under consideration that could be used in conjunction with the industry proposal. These include:

1. a requirement for more comprehensive training for purchasers of small cans
2. an escalating deposit rate until mandatory recycling targets are met;
3. a mitigation fee added to the cost of a small can of HFC-134a and directed to emission reduction projects in this or other sectors.

ARB has also examined a proposed new technology with potential to allow for DIY charging of an MVAC system with more accuracy based on vehicle make and model, and with an ability to check vehicle leak tightness criteria. The technology is not commercially available at this time, but could be considered in the future.

3.3.1 Consumer Education Program

The objective of the education program is to reduce emissions and to build awareness of environmental issues related to high GWP green house gases and climate change. The program would inform the consumer so he is better able to reduce emissions and risks during recharge procedures. The program would educate the consumer on environmental harm due to release of HFCs, legal requirements for recycling and its advantages; methods for trouble shooting the MVAC system, proper techniques for recharging, and instructions to seek professional repair if a major leak is suspected. Course materials developed under the program would identify potential risks to the A/C system if it is overcharged, if it is undercharged, if the lubricant level is too high or too low, and the potential risks to the consumer if inappropriate refrigerants such as HC refrigerants are substituted into systems designed for HFC-134a.

This approach needs cooperation and contributions from trade associations currently engaged in AC education endeavors. Administrative details include development of course materials, and cooperation of retailers to make the information available. Some enforcement activities/audits would be required to assure that materials are available. ARB will be working with the professional industry and small can industry trade associations to establish guidelines for an appropriate course curriculum. It is anticipated that the industry representatives would train retails sales associates. The course information would be available in hard copy at point of sale and in web based form over the internet. The sales associates would make educational information available in the form of a brochure and web links, and they would be also able to answer basic questions. The consumer education course would not substitute for MVAC professional training.

3.3.2 Enhanced Recycling Program

Mandatory recycling with an incentive deposit on cans of refrigerant is the approach proposed by industry to reduce emissions from can heels. ARB acknowledges the contribution of HFC reduction achieved by a recycling

program, but has concerns that it will be difficult to ensure a high return rate. Therefore, ARB suggests modifications to the program to increase the return rate. The recycling program would be managed entirely by the manufacturers of small cans with a deposit placed on each can as incentive to return and recycle the can and its remaining content. An initial deposit may be $5 per can. Regulatory language would set targets for return rates of the can. A backstop will be added into the regulatory proposal. If the return rate is below a target of 95%, then after 12 months of operating the program the deposit would be automatically increased to provide additional incentive for return. This process would be repeated at set intervals until the target rate of recycling is achieved. The increase in deposit would equal the existing deposit, thereby doubling the deposit each year until targets were met. We estimate that a target of 95% is both realistically achievable and captures almost all the can heel emissions. The manufacturers will be responsible for running the program and controlling the deposit money. If recycle rates are too low and deposits must be increased, the consumer has increased incentive to return the can. The manufacturers also have incentive to increase recycle return rates through education because a high deposit presents a purchase barrier to the consumer.

The education program provides the opportunity to fully inform all can purchasers that recycling is required by law. The recycling effort will be strengthened through education and wording on the can label. By combining the education program with the recycle program, a higher return target (95%) can be set and achieved – resulting in greater emission reductions. The emission reductions of the combined proposal are estimated to be 0.22 $MMTCO_2E$ per year and achieve about 47% of the can ban reductions.

The average consumer cost would be $2 million per year higher than BAU for industry resources to administer the program. Prorating $2 million dollars over 0.22 $MMTCO_2E$ on reductions yields a cost-effectiveness estimated to be $9/$MTCO_2E$. Loss of revenue to the small can industry would be very small.

3.3.3 Mitigation Fee

A mitigation fee is being explored as part of the broader program for the high GWP GHG sector. It is an issue much larger than this DIY small can measure. However, we can provide context for how it would work if implemented for mitigating refrigerant impacts. ARB's preference is to control emissions to the extent possible, and then mitigate what remains. In this case it is difficult to control all of the emissions. The fee is a tool that has the potential to cost-effectively mitigate the uncontrollable emissions.

A mitigation fee is an option that could be initiated in isolation or along with the recycling and education program. A fee added to the purchase price of small cans of HFC-134a could affect greenhouse gas emissions in two ways. First, the fee could cause reduction in consumer use of small cans if the fee were set high

enough. Second, the fee could be used to support mitigation programs, either in the GHG sector or outside the sector, thus "neutralizing" the emissions from the can use. The fee would be collected at time of purchase, and then the retailer would forward the fees to a designated account at specified intervals. This concept could be used as a stand-alone approach or combined with emission reductions options.

The intention of this discussion is not to specify a market or set a fee. Instead, the purpose of the example is to show the relationship between fees per ton of CO_2 equivalent and per can fees. For example, if the fee were set at \$25/MTCO_2E, then the fee for a typical can would be about \$11/can. If the mitigation fee was used to generate reductions equal to the CO_2 equivalent content of the small can, then the mitigation fee would translate into a cost-effectiveness of \$25/MTCO_2E.

ARB staff are currently in the process of identifying legal, technical, and practical constraints with the inclusion of a mitigation fee. It would set precedent in the use of fees to mitigate GHG emissions, and it would require that a system be developed for collecting the fees and in turn distributing them to favorable projects that consider several criteria such as verification standards for permanence, additionality, leakage, etc. The mitigation fee approach is attractive for HFCs because each small container has very high global warming impacts. A typical small can with 12 ounces of HFC-134a contains nearly half a metric ton of CO_2 equivalent emissions. This is equivalent to driving a car with moderate fuel economy (21 mpg) over 1000 miles. The fee approach appears to be cost-effective and reasonable in actual cost to the consumer. The mitigation fee approach could be added to the recycle and education program, or it could stand alone. However, as a stand alone measure, the mitigation fee is not directly reducing MVAC HFC-134a emissions. Instead the fee is used to reduce emissions elsewhere. The fee can serve as a complement to other emission reductions from this sector or serve as a bridge to promote the development of safe, effective, lower-GWP alternatives.

Enforcement provisions would be necessary to monitor and audit the small can sales to ensure that the mitigation fee is properly applied to each container and that all of the mitigation funds are being directed in a manner consistent with that established under the program. The mitigation fees being used to fund GHG emission reduction programs such as refrigerant recycling would be audited. Periodic audits would be expected to ensure that mitigation fees are appropriately directed.

3.3.4 Other Technical Approaches

Other technical approaches for mitigation of emissions will be considered should they become available. For instance, staff is aware of proponents advocating the deployment of new equipment allowing DIY consumers to extract refrigerant from

their MVAC system and then to recharge their system only if the system is leak free. If new technologies do become available for DIY charging and recharging MVAC systems, those options will be considered in a future modification of this regulation.

3.3.5 Additional Rule Making on Professional A/C Servicing

The practice of professional service technicians is not emissions free, and staff recognizes that emission reductions can be achieved in the area of professional A/C servicing. Current research sponsored by ARB suggests that there is large variation in the practices of professional A/C servicing. Professionals may misdiagnose a properly functioning system. Professionals may fail to identify a leak problem and simply top off the system. Clearly, a sales restriction on sale of small cans would shift AC servicing away from the DIYer onto the professional. **Without regulation of professionals, the shift might result in unchecked windfall profit to the professional mechanic with no assurance that real emission reductions are being achieved in all cases.** A companion measure to ensure emission reductions and consumer protection would be very important in the case of a sales restriction. Even in the absence of a sales restriction, control of emissions from professional servicing is important because the majority of A/C servicing is performed by professionals. Approaches to regulating emissions from professional servicing require careful consideration. Regulation of the professionals is complex due to the interplay between requirements of the U.S. EPA and the California Bureau of Automotive Repair (BAR).

California could require that the 30-pound cylinders of HFC-134a commonly used by professionals be recycled and require a deposit on the cylinders to promote recycling of the can heel. These mitigation approaches are expected to be addressed in a separate rule ARB is developing for practices associated with stationary refrigeration systems (ARB, 2008c).

California could require all professionals to undergo an education program and obtain a license to purchase and use large cylinders of refrigerant. California could require that MVAC professionals be required to repair systems before being permitted to recharge them, as federal law currently does for large, fixed refrigerant systems. These two requirements would be accomplished through a separate rule making and would involve BAR which presently regulates the practices of automotive technicians. New enforcement would also be needed to ensure the effectiveness of the new program.

4. Staff Recommendation

Staff has analyzed two approaches to reducing emissions from DIY servicing: a can ban and a recycle plus education program. While both options remain open for consideration by the Board, staff recommends the recycle plus education approach because it achieves nearly half the emission reductions of a ban, but is

far more cost effective than a ban, and does not impose hardships on the EJ community. Further, it focuses directly on the emissions attributable to the small cans rather than attempting to solve the general problem of leaking vehicles by focusing on the small can. Finally, the recycle and education program is a form of public outreach on climate change issues, generating positive behavior; while a ban would generate scofflaw behavior and negative attitude. The recommended mitigation approach to reduce emissions from non-professional servicing of MVAC systems includes the following regulatory requirements:

1. A self-sealing valve on all containers of HFC-134a refrigerant less than 30 lbs intended for MVAC use,
2. Mandatory can return and refrigerant recycling, enforced by regulation and enhanced by a deposit incentive,
3. Mandatory increase of the recycling incentive deposit at set intervals until the target rate of recycling is achieved.
4. Improved labeling on can, including precise instructions for use and a statement that by law, the can must be recycled, and
5. A comprehensive consumer education program describing the legal, environmental, and MVAC issues associated with using small cans for DIY recharge. The consumer education material would be available free of charge at the point of sale and over the internet.

Auxiliary approaches that may be considered if feasible include:

- Leaving the option open for assessing new and superior technology or methods for DIY servicing, and
- Adding a mitigation fee that would be part of a subsequent sector-wide effort.

Items that will be addressed via other ARB measures include:

- Adding regulations to professional A/C servicing, particularly a deposit and recycle program for large cylinders of refrigerant.
- Allowing only A/C professionals to purchase larger cylinders.

The recycle plus education approach achieves a moderate emission reduction at low cost while not imposing an economic hardship or quality of life hardship (lack of air conditioning) on DIY consumers, especially low income consumers. The approach improves public awareness of climate change issues and promotes taking positive action to help solve the problem.

5. Summary

ARB staff is in the process of developing this Discrete Early Action Measure – *Reduction of HFC-134a Emissions from Non-Professional Servicing of Motor Vehicle Air Conditioning Systems.* Two primary mitigation options are under consideration:

- Restrictions on the sale of small cans, proposed by ARB, and

- Addition of self-sealing valves, improved instructions on the can, and initiation of a can return and refrigerant recycling program, proposed by industry.

ARB staff proposes auxiliary options that can be added to the industry proposal to improve effectiveness. These possibilities include:

- An escalating deposit incentive that increases each year until recycling targets are met.
- A comprehensive education program to improve the awareness and performance of DIY consumers.
- A mitigation fee commensurate with GWP of can contents added to purchase price,
- Other technological approaches as they become available.
- Additional regulations for professional servicing to be addressed through separate rulemakings.

Staff recognizes that the first strategy, restriction on can sales, will place some economic hardship on the low-income sector of the public. The Environmental Justice Advisory Committee, certain Board members, and some State legislators have written to express serious concerns about this regulatory proposal. This strategy would also engender program leakage through internet sales and out of state sales, along with a corresponding negative scofflaw attitude among a large segment of the public.

An analysis of the industry-proposed recycling strategy indicates that it will be less costly to the consumer but will result in smaller GHG emission reductions. The industry proposal is complex due to the difficulties in establishing and monitoring a container return and refrigerant recycling program, establishing certification programs for the self-sealing valves, and establishing a refrigerant recovery process; but this burden is borne by industry and industry agrees to these additional requirements. The original industry proposal would have no impact on DIY usage, and would have an uncertain recycling rate. To improve the recycling rate, ARB would assess recycle rates annually and increase mandatory deposit amounts until recycle targets are met. The education program will create better educated DIY individuals, reduce emissions due to better practices while recharging, result in more leak detection and repair, and result in fewer can purchases due to identification of risks and identification of systems in need of significant repair. It is anticipated industry and trade associations would develop and deliver course content and ARB would approve course content.

ARB recognizes that there are other options that may be used to address emissions from MVAC operations. Professional servicing has unnecessary emissions and ARB is developing separate rulemakings to address them. A mitigation fee would not necessarily reduce emissions within this sector, but emissions would be mitigated via another strategy. A full program would need to be developed for collecting and distributing the fees. Mitigation fees will increase

the purchase price of a can, but will still be far more cost-effective than professional servicing.

These considerations led staff to recommend an approach utilizing key features from auxiliary mitigation proposals which achieve emission reductions equivalent to 47% of those achieved by a can ban while having a relatively small cost impact on low income DIY owners. The recommended mitigation approach to reduce emissions from non-professional servicing of MVAC systems includes the following features:

1. A self-sealing valve on all containers of HFC-134a refrigerant less than 30 lbs intended for MVAC use,
2. Mandatory recycling, enforced by regulation and enhanced by deposit incentive,
3. Mandatory increase of the recycling incentive deposit at set intervals until the target rate of recycling is achieved.
4. Improved labeling on can, includes precise instructions for use and a statement that by law, the can must be recycled, and
5. A comprehensive consumer education program describing the legal, environmental, and MVAC issues associated with using small cans for DIY recharge. The consumer education material would be available free of charge at the point of sale and over the internet.

A summary of emission reductions gained by each approach and the estimated cost-effectiveness is presented in Table 1.

Table 1. Summary of Emissions Reduction & Cost-Effectiveness by Mitigation Approach

Scenario	Emissions $MMTCO_2E/yr.$	Emission Reductions $MMTCO_2E/yr.$	Cost-Effectiveness (Consumer Side) $Dollars/MTCO_2E$	Lost Revenue Million Dollars/yr.
BAU	0.71	NA	NA	NA
ARB Can Ban	0.24	0.47	135	25
Industry Proposal*	0.52	0.19	19	0
Enhanced Industry Proposal**	0.49	0.22	9	<1
Fee-for-Mitigation	0.85	0.85	25***	0

* Assume 75% of cans are returned, no change in DIY behavior

** Target on 95% of cans are returned, improved DIY behavior

*** Depends on Carbon Market Price

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